Supplementary Information

Oxido- and dioxido-vanadium(V) complexes supported on carbon materials: reusable catalysts for the oxidation of cyclohexane

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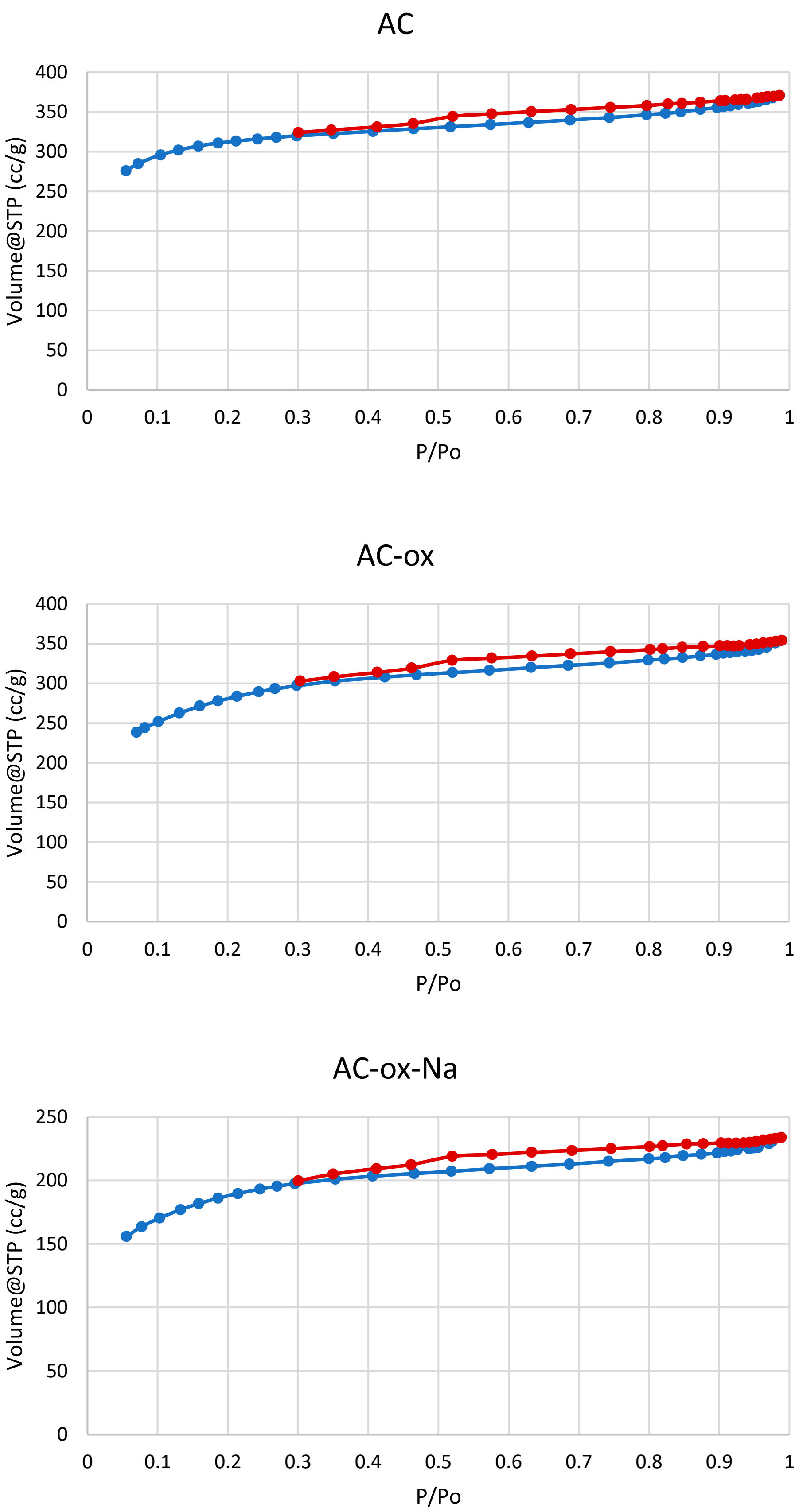

Figure S1. N_2 adsorption isotherms of AC, AC-ox, AC-ox-Na.

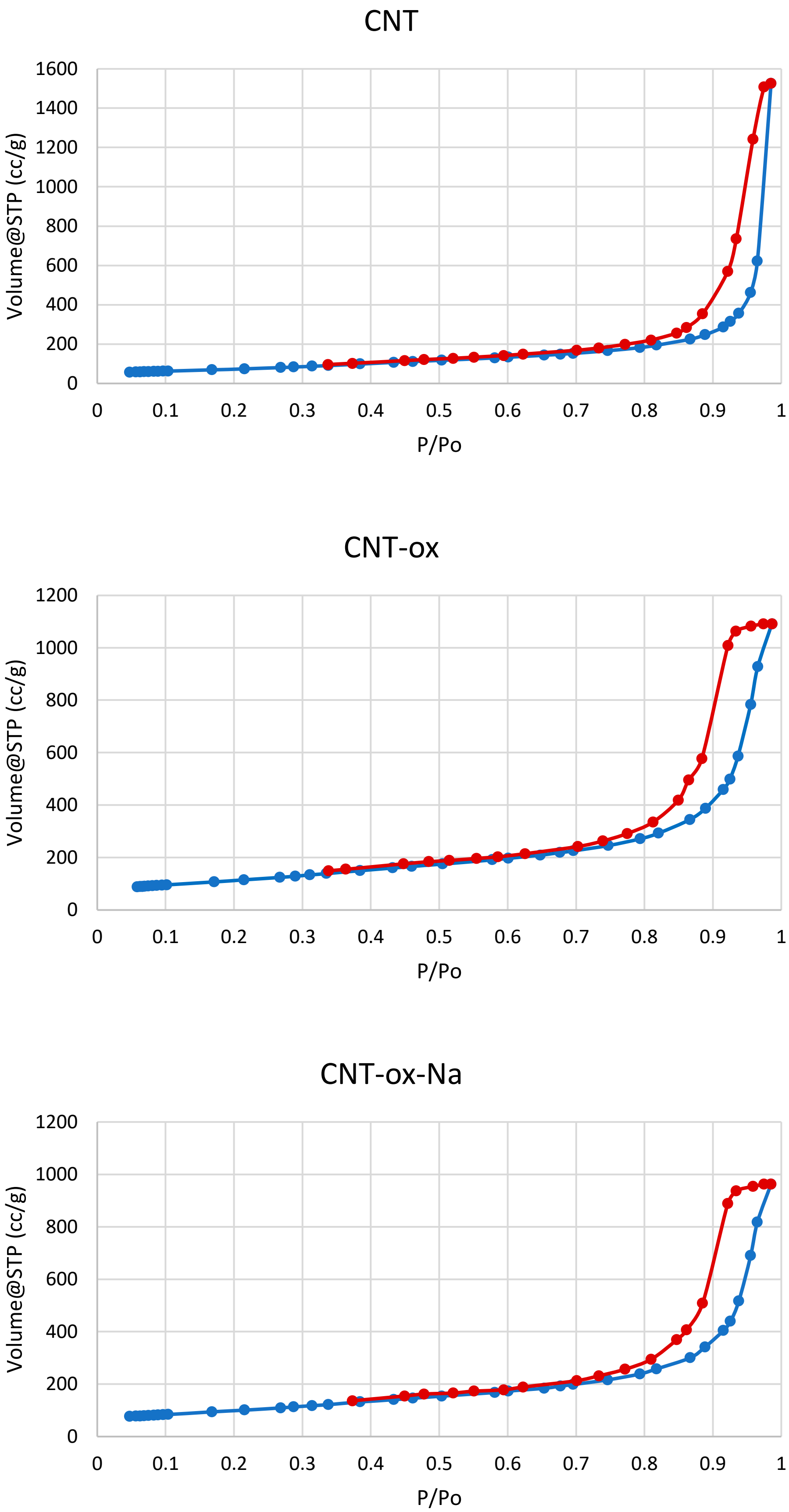

Figure S2. N_2 adsorption isotherms of CNT, CNT-ox, CNT-ox-Na.

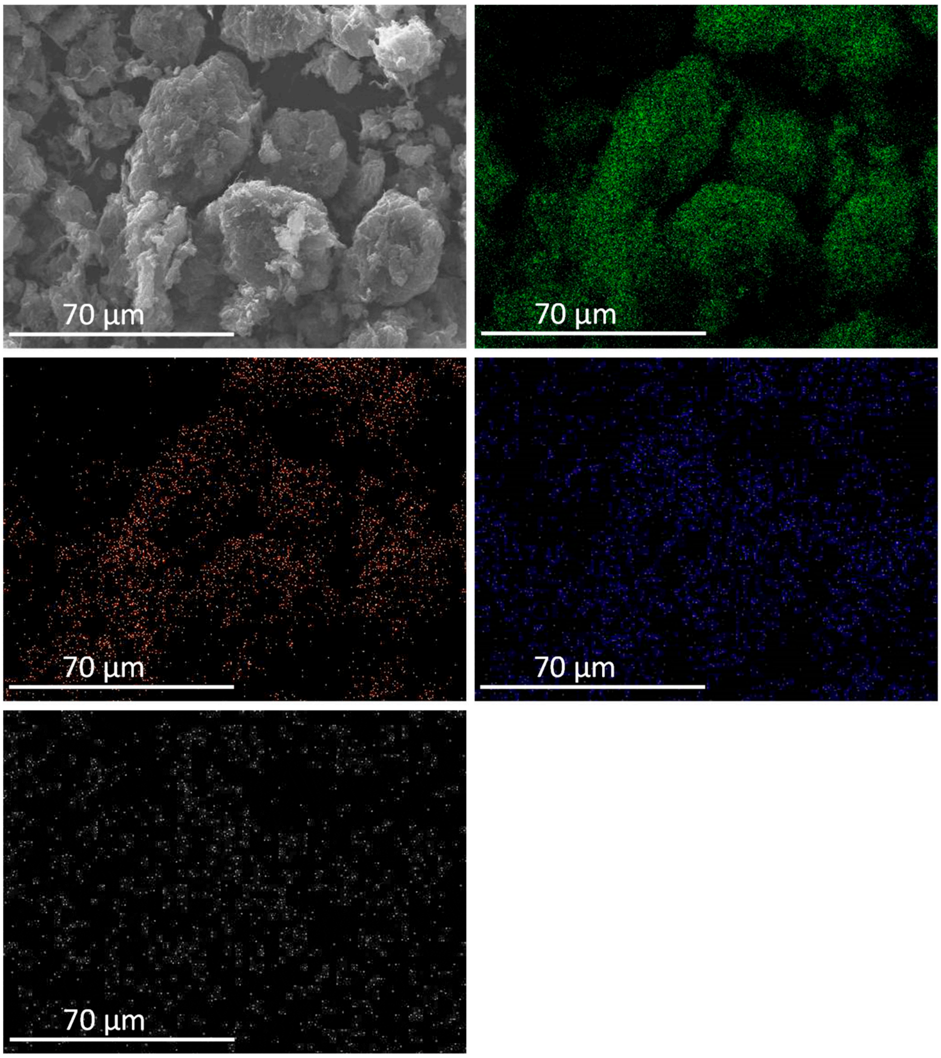

Figure S3. SEM-EDX mapping for sample **V1**@CNT-ox: C (green), O (pink), Br (blue) and V (white).

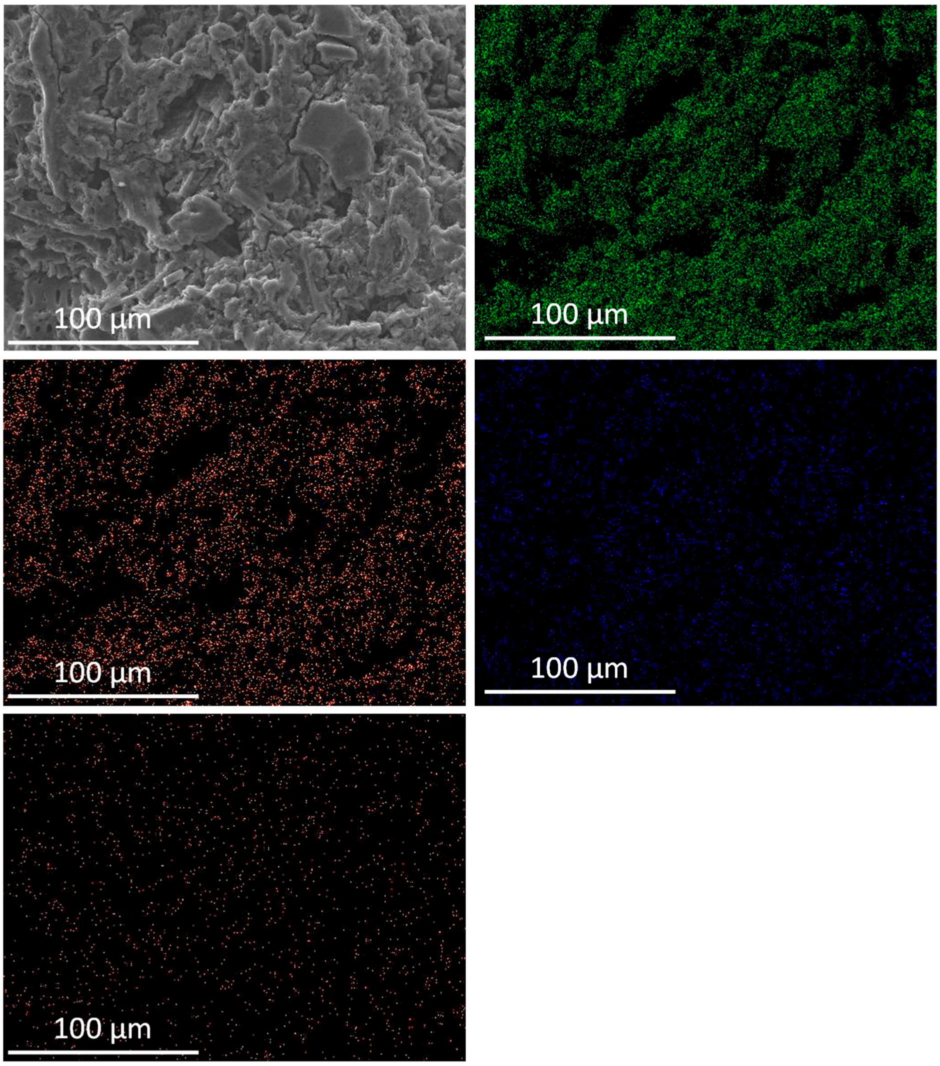

Figure S4. EDX mapping for sample **V2**@AC-ox: C (green), O (pink), Br (blue) and V (white).

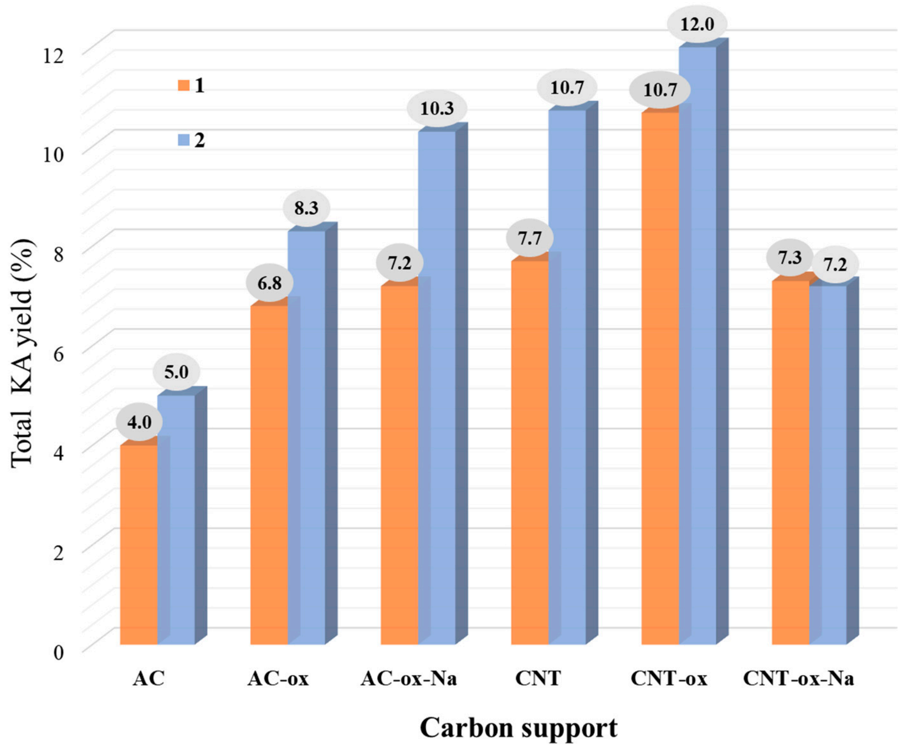

Figure S5. Total yield of KA oil obtained by the MW-assisted oxidation of cyclohexane at 80 °C, 20 W, for 2 h, supported on different carbon materials.

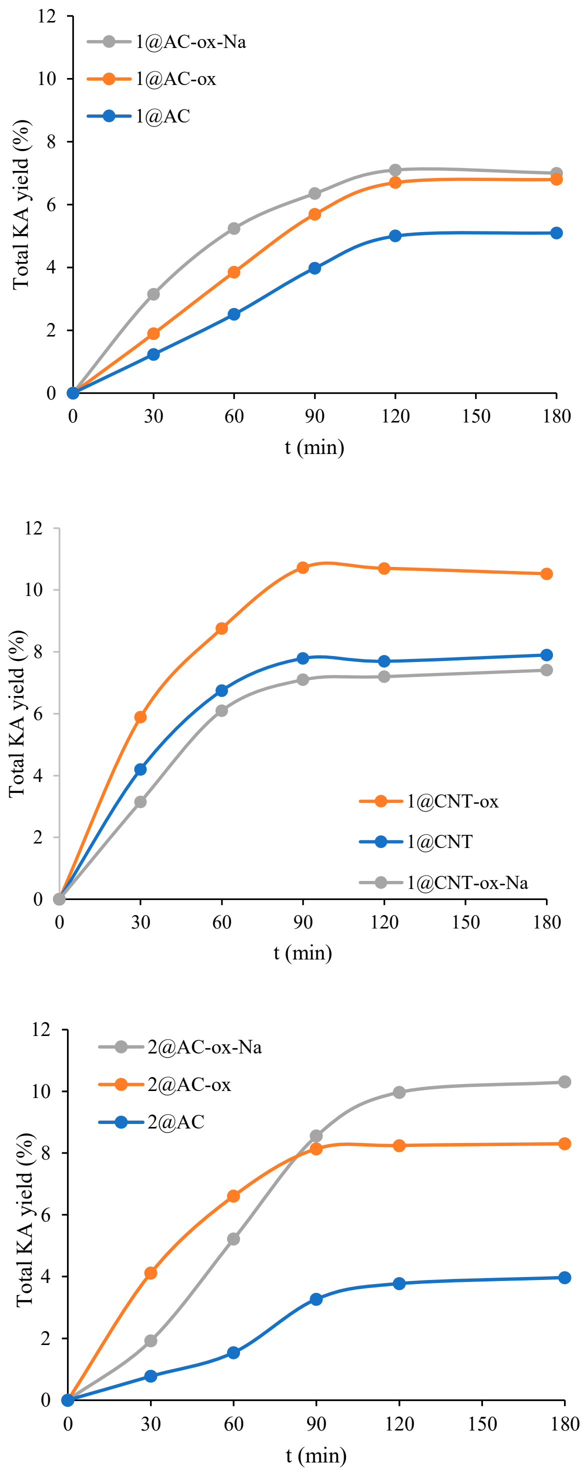

Figure S6. Effect of the duration of the MW irradiation on the catalytic activity of supported oxidovanadium complexes for the oxidation of cyclohexane with TBHP in MeCN.

Table S1. Summary of uses of carbon-supported oxidovanadium complexes in various catalytic reactions and major outcomes.

Reaction	**Vanadium complexes**	**Carbon support**	**Catalytic results**	**Catalyst stability**	**Ref**
1-phenylethanol oxidation	Oxovanadium (V)	Functionalized MWCNT, AC and CX	96 % acetophenone yield, > 98% selectivity	90 % of the catalytic activity was observed by the 10th cycle.	[1]
Oxidation of alcohols	Oxovanadium Schiff base	Graphene nanosheets	96 % of benzohydrazone	Efficient recycling of the catalyst over six runs.	[2]
Cyclooctene oxidation	Hydroxyl functionalized oxovanadium(IV) Schiff-base	Modified MWCNT	Cyclooctene epoxide (08.6%), cyclooctene-1-ol (52.5%) and cyclooctene-1-one (28.9%).	Reused for three times without neither loss of activity or selectivity.	[3]
Styrene oxidation	Oxovanadium(IV) acetylacetonate	Amino-modified CMK-3	66.7 % yield of styrene oxide with a selectivity of 70.5 %	A decrease of 10 % in conversion and < 10 % selectivity to styrene oxide were reported.	[4]
Styrene epoxidation	Oxovanadium(IV) salen	Amino-modified graphene oxide	18.5 % styrene epoxide, and 21% selectivity	Three recycling runs for the catalyst with a 10 % conversion drop and slight selectivity decrease (< 5%).	[5]
	Oxovanadium(IV) salen	Carbon-coated Fe_3O_4 hybridized with graphene	54.6 % yield of styrene epoxide with 59.2% selectivity	For two cycles, almost no leaching was observed; both yields and selectivity were maintained.	[6]
	Oxovanadium(II) Schiff base	Amino-functionalized graphene oxide	16.7 % yield of styrene epoxide with 20.7 % selectivity	No significant loss of activity and selectivity after successive runs (<5 %).	[7]
Epoxidation of oleic acid	Oxovanadium Schiff base	Functionalized graphene oxide	98.9 yield of the epoxide with 99.1 % selectivity	The catalysts could be successfully recycled and reused for six runs without a significant decrease in activity or selectivity.	[8]
Epoxidation of geraniol	Oxovanadium(IV) acetylacetonate	CMK-3	Conversions > 98% and 98-99% selectivity for 2,3-epoxygeraniol	For two cycles, almost no leaching was observed; both yields and selectivity were maintained.	[9]
Oxidation of p-chlorobenzenethiol	Oxovanadium (IV) complex	Amino functional microporous organic nanotube frameworks	100 % conversion was reported with 98 % selectivity.	The material was recycled more than 8 times with no apparent decrease in catalytic activity	[10]

Table S2. Supported vanadium complexes in cyclohexane oxidation and major outcomes.

Vanadium complexes	Support	Yield (%)			Selectivity to KA oil (%)	Catalyst stability	Ref
		A	K	O			
Oxidovanadium(V)	Functionalized AC and CNT	7.0	5.0	-	~100	Activity drop of 28 % by the 4th cycle.	This work
Functionalised oxidovanadium(IV) Schiff-base	Modified MWCNTs	62.5	8.9	7.5	90.5	No leaching was observed.	[11]
Oxidovanadium(IV)	PDMS	4.7	1.0	-	~100	The activity of the recycled catalyst was much lower.	[12]
V-scorpionate complex	MOR zeolite	7.9	43.9	-	~100	Loss of activity in the recycling tests: 18 % in the 4th cycle.	[13]
Vanadium phosphate	Mesoporous KIT-6 silica	4.9	8.6	5.8	69.9	A conversion decrease of 30 % was observed by the 5th cycle.	[14]
$VOSO_4$	HTS (TiO_2-modified material)	0.1	2.7	13.4	21.7	-	[15]
Vanadium phosphorus oxide (VPO)	SBA-15 and TUD-1 silicas	1.0	30.0	-	~100	-	[16]

A- cyclohexanol; K- cyclohexanone; O- others; AC-activated carbon; CNT- carbon nanotubes.

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